

# Annual Report

of the

## Director of the Bureau of Standards

to the

### Secretary of Commerce and Labor

for the

Fiscal Year Ended June 30, 1904



Washington  
Government Printing Office  
1905



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DEPARTMENT OF COMMERCE AND LABOR

Document No. 39

BUREAU OF STANDARDS

# REPORT

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## DIRECTOR OF THE BUREAU OF STANDARDS.

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DEPARTMENT OF COMMERCE AND LABOR.

BUREAU OF STANDARDS,  
*Washington, D. C., July 1, 1904.*

SIR: I have the honor to submit the following report of the operations of this Bureau for the fiscal year ended June 30, 1904:

During the fiscal year ended June 30, 1904, the work of the Bureau has been carried on in the temporary quarters previously occupied in the Butler and Coast and Geodetic Survey buildings and at No. 235 New Jersey avenue SE., and for a portion of the year a part of the work has been conducted in the new mechanical building on Pierce Mill road, near Connecticut avenue NW.

The offices of the Bureau, together with the section of weights and measures and the section of resistance and electromotive force, have been, as heretofore, in the Butler and Coast and Geodetic Survey buildings. The sections of heat and thermometry and of light and optical instruments have remained during the year in the temporary laboratory fitted up two years ago at No. 235 New Jersey avenue.

The instrument shop was moved into the new mechanical building in the winter and the following sections established themselves in the laboratory rooms of the same building in the spring: (a) Inductance and capacity; (b) electrical measuring instruments; (c) magnetism; (d) photometry; and (e) engineering instruments. The various sections of the Bureau have thus been enabled to expand their work, the sections remaining behind in the temporary quarters having occupied the space vacated by those moving into the new building.

The physical building is to be completed by the terms of the contract during August next, but it will not be ready for occupancy before October. This building, which is connected with the mechanical building by a spacious tunnel, so that the two are practically one building so far as service and facilities are concerned, is the larger of the two and will accommodate the offices and library and a large part of the research work and testing of the Bureau. The two buildings will

provide for the present work of the Bureau and the temporary quarters now occupied will be surrendered.

In addition to the heating and ventilating system, plumbing, steam boilers, pumps, filters, and auxiliary apparatus installed by the Office of the Supervising Architect as an initial equipment for the buildings, the Bureau has installed during the year a considerable amount of apparatus and machinery in the mechanical building. The more important items of this list of apparatus and machines are the following: A tandem compound engine of 120 horsepower, with two direct-current dynamos of 75 kilowatts combined capacity; a simple engine of 50 horsepower and two dynamos of 30 kilowatts combined capacity; a motor generator for charging storage batteries and a motor-alternator testing set; three motor-generator testing sets brought from the temporary laboratory at 235 New Jersey avenue; two storage batteries; a switch board for all the generators and testing machines, storage batteries, and distributing lines; an ammonia refrigerating machine of 30 tons capacity, together with a small ice-making plant; a gas-making machine for laboratory use, and a large air compressor to be used in connection with a liquid-air plant yet to be installed.

The sum of \$1,500 was appropriated by the last Congress for grading grounds and building walks and roads. Of this amount \$500 was made immediately available, and has been expended in constructing a walk from Connecticut avenue to the laboratories and a roadway from Pierce Mill road to the mechanical building. The balance will be expended after July 1 for paving and grading about the mechanical building and making a short piece of macadamized road.

#### SCOPE OF THE BUREAU'S WORK.

The testing work done by the Bureau is much more extensive and important than the table of tests and fees would indicate. It was never expected that the fees received for testing would amount to a sum comparable with the total expense of the Bureau, and yet the amount of fees will increase largely year by year as the work develops and the force increases. By far the greater part of the work of the Bureau is that of investigation in connection with the improvement of standards and methods of measurement, hence it is necessary to maintain a force of men and an equipment for doing scientific work of the highest grade. The act of Congress authorizing the establishment of the Bureau of Standards provided that the Bureau should acquire and construct, when necessary, copies of the standards adopted or recognized by the Government, their multiples and subdivisions; should compare with these standards the instruments and standards employed in scientific investigations, engineering, manufacturing, commerce, and in educational institutions; should conduct researches



pertaining to precision measurements, and should determine physical constants and properties of materials. Granting that the primary purpose of the Bureau is to do testing for the Government and the public, it is evident that the wide range of work provided for in the act establishing the Bureau is necessary, in order that testing of the highest grade may be done.

The Bureau is the custodian of the legal standards of length of the United States, and hence every precision standard used by manufacturers of bars, rules, tapes, or other measuring instruments, or by engineers or surveyors in laying out buildings or measuring land, or by the States or the Government in running boundaries or making maps or charts, or by scientific investigators in all research work, must come directly or indirectly from the Bureau of Standards. Similarly the Bureau is the custodian of the legal standards of mass, and every manufacturer of scales and balances, from the delicate balances used by chemists and assayers to the heaviest scales used in commerce, depends directly or indirectly on the Bureau for his standards. Manufacturers' standards are not made by the Bureau except in rare cases, but are purchased from the makers of standard weights and measures and brought to the Bureau from time to time for comparison with the standards of the Government. The degree of precision with which they are compared with the fundamental standards varies from that required in the standards for ordinary weights and measures to that which is necessary in the standards used in scientific work which demands the application of the most precise methods of measurement known. The importance to manufacturing, commercial, and scientific interests of correct standards and uniformity of measurements of length, mass, and capacity is readily understood; but it is equally important that these interests be properly provided with accurate standards for measurements of electricity, heat, illumination, pressure, power, and other quantities. Moreover, the standards involved are far more complex. Their preparation and comparison involve measurements and investigations of the highest order in practically all branches of physics and chemistry. This work includes the verification of the volumetric apparatus used by chemists in all kinds of analytical work; the testing of precision thermometers used in scientific work or as standards by thermometer manufacturers, and of clinical thermometers and the standards employed in their manufacture, and the standardization of instruments for measuring low temperatures used in scientific work, and of pyrometers for measuring high temperatures in connection with the steel, glass, pottery, and other industries. The importance of a knowledge of the temperatures employed in these industries is now well understood. The instruments involved are, moreover, subject to error and must be compared from time to

time with the standards. The standards and measuring instruments employed in the electrical industries are no less important or varied in their nature. They involve standards of resistance and electromotive force, the two most fundamental units employed in electrical measurements. Every manufacturer or user of electrical measuring instruments or machinery must depend directly or indirectly upon these standards, as well as standards of capacity and inductance. The Bureau also maintains a laboratory for the preparation and testing of standards of illumination used in the manufacture of electric lamps or the testing of gas, oil, and other illuminants.

The illustrations given refer only to the more important branches of the Bureau's work, yet they serve to show its wide range and its scientific as well as commercial importance. Obviously, the Bureau of Standards, occupying the position of a court of highest appeal in matters pertaining to weights and measures, must possess material standards as perfect as possible; the methods of measurement employed must be the latest and best; the instruments used must be the most effective that can be bought or built; the laboratory facilities should be complete in all respects; and, finally, the men in charge of the work and their assistants must be able, well trained, and experienced.

#### WEIGHTS AND MEASURES.

In addition to an unusually large amount of routine testing done in this section during the year, considerable attention was given to the designing and construction of new apparatus. This work included the preparation of plans for a 50-meter tape comparator and also an arrangement for comparing 5-meter base standards for geodetic work. To accommodate these comparators the entire length of the tunnel connecting the mechanical and physical laboratories was divided into two parts by a brick wall. That part of the tunnel devoted to the comparators is about 2 meters wide, and against one wall will be placed the 50-meter and the 150-foot tape standards, while the base bar comparator will be near the opposite wall. When completed the facilities for work of this character will be equal if not superior to any in existence.

Plans are also being prepared for a comparator for testing end-standards and gauges up to 500 millimeters, or 20 inches in length. End-standards and gauges are used almost exclusively for precise mechanical work; manufacturers of these gauges now work so accurately that one of the most difficult problems is to determine with sufficient precision the absolute length of the standards employed. It is also proposed to study with this comparator various methods of contact used with end-standards.

Designs for standard weights and measures for the use of State, county, and city sealers were completed during the year and placed in the hands of several manufacturers. These supply a long-felt want.



Sealers may now purchase sets of standards specially designed for their use and send them to the Bureau to be verified and stamped.

Early in the year a notice of a proposed meeting of State sealers was sent to the governors of all the States, but as a great many replies indicated that no funds were available for the purpose of sending representatives, it was decided to postpone the meeting until January, 1905. The object of this meeting is to discuss means for securing greater uniformity in the laws and practices concerning weights and measures in the United States; also to bring about closer relations between the Bureau and State officials. In order that the data for intelligent discussion of the subject may be had, the Bureau is compiling the laws of all the States, as well as the national laws, relating to weights and measures. This information has never been available, for the reason that it is scattered through many volumes seldom accessible to those interested in the subject.

In addition to the equipment which is being designed and constructed in the Bureau for the section of weights and measures, a number of precision balances of the highest grade have been ordered. One of these balances will permit of weighing being done in vacuo. While the reduction to vacuo of weighings can ordinarily be made with all needful accuracy by observing the temperature, humidity, and pressure of the air and making correction for the air displaced by the weights, these methods are indirect and should occasionally be verified by actually weighing in vacuo.

Satisfactory progress has been made in meeting the demands of chemists for the calibration of volumetric apparatus used in exact analytical work. A rapid volumetric method for testing flasks and similar measuring apparatus was devised and thoroughly tested in the verification of a large number of 100 cubic centimeter sugar flasks submitted by the United States Treasury Department. This method will be applied to the calibration of flasks and graduated cylinders of all sizes. Considerable work was done for the Public Health and Marine-Hospital Service, for which higher accuracy was required than has previously been attempted with glass volumetric apparatus. The apparatus was for use in the preparation of diphtheria and other antitoxins, and it is essential that all apparatus used in their manufacture be as correctly graduated as possible.

Regulations were issued by the Bureau for the testing of such measuring apparatus. They were based upon the experience of the foreign standardizing laboratories and upon experiments conducted at this Bureau after consultation with a committee representing the American Chemical Society and with manufacturers of chemical glassware.

Numerous aneroid barometers for the use of the Navy Department and for individuals have been tested during the year. The capacity of the apparatus used for this purpose is too small, and it is proposed

to greatly increase the size of the variable pressure chamber and to provide facilities for rapidly raising and lowering the temperature of the chamber in order to determine the effect of temperature upon the indication of the aneroids.

The national prototype meter of the United States was taken to Europe and recompared with the standards of the International Bureau. This is the first time that this standard has been compared since the original comparison made under the direction of the International Committee in 1888 and 1889. The results of the comparison indicate a very satisfactory constancy in the length of these standards and will be given in detail in the first number of the Bureau bulletin.

Considerable attention was given by this section to the exhibit of the Bureau at St. Louis. Six large cases containing weights and measures of historical interest and types of the best foreign and United States weights and measures were shown, the purpose being to show the progress that has been made in the construction of material standards and to illustrate their form and variety.

Among the more important pieces of work done in this section during the year may be mentioned the graduation and comparison of a standard metric bar for the Canadian government and the repair, readjustment, and verification of the Wisconsin standard weights and measures.

Plans for the equipment of a laboratory for testing time-measuring apparatus were also made during the year. The first requisite is a standard clock of such construction and workmanship that it shall have a minimum of imperfections and shall be affected as little as possible by changes in temperature and atmospheric pressure. A clock fulfilling these requirements has been ordered for delivery about December, 1904. For recording the time, making clock comparisons, rating chronometers, and for use in testing other time-measuring apparatus a double-pen chronograph has been secured.

#### HEAT AND THERMOMETRY.

During the year a laboratory has been equipped for testing instruments used for the measurement of high temperatures, so that the Bureau is now in a position to standardize almost every type of pyrometer. Pyrometers have not yet found as wide application in American industries as abroad, and the advantages resulting from their use in the control and duplication of products are just beginning to be realized. Since the establishment of this laboratory many engineers and experts of varied industrial concerns have visited the Bureau and have taken great interest in this work. During the year some of the best optical and radiation pyrometers at present available have been investigated, as it is in this field that the most marked advances have been made in recent years in the measurement of high temperatures.

including even the extreme temperatures of the electric arc. The results of these investigations will be published in the near future.

A special comparator designed for the testing of mercurial thermometers in the interval  $0^{\circ}$  to  $100^{\circ}$  C. was constructed in the instrument shop. This comparator has also been used for the inter-comparison of a number of primary standard mercurial thermometers, constructed by Tonnelot and by Baudin, which have been subjected to an elaborate investigation at the International Bureau of Weights and Measures.

The Bureau has acquired during the past year a number of primary standard mercurial thermometers in the interval from  $0^{\circ}$  to  $550^{\circ}$  C., constructed by Baudin, of Paris, and by Niehls, of Berlin. The inter-comparison of these thermometers and the comparison of the scale which they define with the scale defined by a number of platinum resistance thermometers is of fundamental importance, as on this work depends the standard scale of temperature of this Bureau in the interval  $0^{\circ}$  to  $550^{\circ}$  C. Several specially designed platinum resistance thermometers have been received from the Cambridge Scientific Instrument Company. A special Wheatstone resistance box has been designed for use with the platinum thermometers for work of the highest precision.

The development of methods and the design and construction of the necessary apparatus for the testing of clinical thermometers, which have been under way for some time, were carried to a satisfactory conclusion during the past year, and on December 15, 1903, the Bureau issued a circular (No. 5) on The Testing of Clinical Thermometers, giving the conditions and test requirements that such thermometers must satisfy in order to receive the certificate and official seal of this Bureau, together with the table of fees for testing.

At the beginning of this work large errors were found in the product submitted for test. An investigation of the standards used by manufacturers showed that these were often in error by amounts that could by no means be neglected. During the past year most of the leading manufacturers have submitted their standards for test. Many have constructed new sets of standards. In some instances these standards were pointed by the Bureau, returned to the maker for graduation, and resubmitted to the Bureau for test. In order to further facilitate the use of standards of proper construction and the general introduction and use of a uniform scale of temperature, the Bureau has loaned for brief periods to a number of manufacturers some of its own standard thermometers, specially designed for the requirements of clinical thermometry. The errors of those now sent for test are less than half as great as at the beginning of this work.

The hearty cooperation and active interest of the manufacturers has done much to facilitate the work. The early experiments to determine



the behavior of clinical thermometers of the average grade were made with thermometers placed at the disposal of the Bureau free of cost, as were the thermometers, made in special forms and of special kinds of glass, used in the experiments on the action of clinical thermometers. The representatives and experts of many of the manufacturers of clinical thermometers have visited the laboratories during the year and have carefully inspected the methods of testing. A large number of tests were made for the several departments of the Government, manufacturers, hospitals, druggists, and physicians.

#### LIGHT AND OPTICAL INSTRUMENTS.

Optical testing and investigations are, in general, of such a nature that they can not be undertaken except with more complete facilities than those afforded by the temporary quarters of the Bureau. There are many investigations to be taken up by this section which must be deferred until the completion of the new physical laboratory. Nevertheless several of the more important ones are under way. The Bureau has been requested by the Treasury Department to cooperate with it in establishing uniform and improved methods for the polariscopic analysis of sugar. New and improved polariscopic apparatus has been secured or constructed, and the Bureau is now in a position to standardize quartz plates and the polariscopic apparatus used in sugar analyses. Preliminary investigations have been made in reference to the application of interference methods to linear and angular measurements; also an investigation of the sources of light used in such measurements and in spectroscopic analysis. The work of this section includes the determination of the optical properties of materials. Several such tests have been made for the public and in connection with the regular work of the Bureau.

#### ENGINEERING INSTRUMENTS AND MATERIALS.

A small laboratory for the testing of engineering instruments has been established in the mechanical building, the equipment of which includes a machine for testing the strength of materials, with a capacity of 100,000 pounds (45,000 kilograms). This will be used for testing materials for this and other Government bureaus and for the public when an authoritative test is required. An apparatus for the testing of water meters has been installed and has yielded satisfactory results; its capacity is limited at present to meters not larger than 2 inches, the type of meter being immaterial. A gas-meter prover of the recognized standard type of 5 cubic feet capacity has been installed in the laboratory and is ready for service. A fluid pressure balance was purchased for the testing of steam-pressure gauges, pending the construction of a mercury column, which will shortly be erected and used



as the primary standard for all work of this kind. A temporary arrangement for the testing of speed indicators has been provided; however, a standard should be adopted in order that the new installation may conform to it. Much of the equipment in this laboratory will serve as a model for the equipment of municipal laboratories and will be used for instruction of officials in charge of them. Numerous requests for information in matters pertaining to this work have been received, all of which were given careful consideration. Among other important matters which have received attention is the establishment of a uniform system of fire hose couplings. An extensive correspondence showed that a great variety of sizes are used in different cities. The standards for several important cities were examined and inquiries were made to ascertain whether a change to uniform standard was feasible. There was unanimous agreement as to the desirability of uniformity, but few cities were willing to change their own systems.

#### ELECTRICAL RESISTANCE AND ELECTROMOTIVE FORCE.

The work of the section of electrical resistance and electromotive force includes the construction and verification of resistance standards and standards of electromotive force, the calibration of resistance boxes, Wheatstone bridges, potentiometers, precision rheostats, and resistance standards for current measurements. A considerable number of pieces of apparatus of this kind have been calibrated during the year. In addition, investigations have been carried on to ascertain how to prepare materials for standard cells, in order to construct cells of uniform electromotive force that will hold their value permanently. A considerable number of cells have been constructed and studied, and some of the results have been published. The work of the section has also been developed in other directions, and some important pieces of apparatus have been added to the equipment.

#### MAGNETISM AND ABSOLUTE MEASUREMENT OF CURRENT.

The section of magnetism and absolute measurement of current was partially organized during the past year, but, owing to the lack of room, apparatus, and men, little testing has been done in the temporary magnetic laboratory in the mechanical building. Several pieces of apparatus for magnetic testing have been purchased, and work has been begun on the accurate graduation of these instruments, so that in a short time this laboratory will be prepared to take up the regular testing of specimens of iron and steel and other magnetic substances.

As a preliminary to the important work of redetermining, in absolute units, electric current and the electromotive force of standard cells, the study of the silver voltameter was taken up. This research

led to the construction of an improved form of silver voltameter, which will be used in future work of this kind at the Bureau. The elastic properties of a large number of materials have been investigated, with special reference to their use as suspensions of the moving coil in connection with an absolute electrodynamicometer now being constructed.

#### INDUCTANCE AND CAPACITY.

This work includes the construction and testing of standards of inductance and capacity and the verification for the public of inductance coils and condensers and the measurements of inductance and capacity of instruments. A considerable number of such tests have been made, and some thorough investigations have been carried out on the absolute determination of inductance and capacity, the preliminary results of which have been published. Investigations on the testing of condensers and studies of various methods of measurements have been carried on during the year. A considerable quantity of apparatus has been added to this laboratory through purchase and construction.

#### ELECTRICAL MEASURING INSTRUMENTS.

The work of the section of electrical measuring instruments includes the investigation and testing of instruments of precision for measuring electric current, electromotive force and power, and the testing of instruments designed for such measurements, as ammeters, voltmeters, wattmeters, and watthour meters, for direct and alternating currents, and special alternating-current instruments, such as frequency meters, phasemeters, curve tracers, etc. A considerable amount of testing has been done, as well as some investigation of instruments and methods of measurement. A series of new alternating-current instruments designed by this section and constructed in the instrument shop of the Bureau has been found to give very satisfactory results in the measurement of current and electromotive force and power, through a wide range of current and voltage. Some special forms of alternating-current generators, designed by this section and constructed for the Bureau, have proved of great value in testing instruments. During the coming year a number of important additions are to be made to the equipment.

#### PHOTOMETRY.

Considerable progress has been made in the development of the work in photometry. The number of tests of standards of illumination has increased steadily, and several tests of a special nature have been undertaken, of which may be mentioned particularly the investigation of the relative illuminating power of several kerosene oils,

which is not yet completed. One line of work which has developed during the past year is the commercial testing of incandescent electric lamps for the various departments of the Government. The present force and equipment are very inadequate; however, much attention is being paid to the development of the work. To this end, plans have been made and some apparatus has been ordered for a commercial photometer with which it will be possible to test a great number of lamps in a relatively short time. An integrating photometer for the measurement of mean spherical candlepower is being constructed in the instrument shop of the Bureau, which, together with the apparatus already in use, will constitute a fairly complete equipment for the testing of incandescent lamps. Subsequently, preparations will be made for the testing of other light sources, such as arc lights and illuminating gases.

In addition to the testing and the equipment of the laboratory some work of investigation has been undertaken. Preliminary to the designing of the integrating photometer mentioned, a theoretical study of the instrument was made, which led to several improvements. Other investigations of photometric problems have been outlined, and some apparatus has been designed and purchased.

#### CHEMICAL WORK.

Owing to the lack of permanent laboratory facilities the work of the chemical division is as yet incompletely organized. During the past year a room in the Bureau of Chemistry of the Department of Agriculture has been occupied by courtesy of the Secretary of Agriculture and the Chief of the Bureau of Chemistry. Some work has been done there, in cooperation with a member of another division, in the preparation and examination of pure materials for use in constructing standard cells for the measurement of electromotive force. Much time has been devoted to the planning of the arrangements and equipment of the new laboratories.

In conjunction with a committee of the American Chemical Society and with the head of the section of weights and measures, specifications have been prepared for the manufacture of apparatus for volumetric analysis which will be received by the Bureau for verification, and for the testing of such apparatus. Some work has also been done in connection with another committee of the American Chemical Society upon the subject of purity of chemical reagents.

#### OFFICE.

The following publications have been issued during the year: Annual Report of the Director; Chart of the International Metric System of Weights and Measures, issued February 11, 1904; Circular No. 1,



Verification of Standards and Measuring Instruments, issued December 1, 1903; Circular No. 2, Verification of Metal Tapes, issued December 1, 1903; Circular No. 3, Verification of Standards of Mass, issued December 10, 1903; Circular No. 4, Verification of Standards of Capacity, issued December 10, 1903; Circular No. 5, Testing of Clinical Thermometers, issued December 15, 1903; Circular No. 6, Verification of Electrical Standards and Measuring Instruments, issued February 15, 1904; Circular No. 7, Pyrometer Testing and Heat Measurements, issued April 15, 1904.

The staff of the Bureau consisted of 58 persons, distributed as follows:

Director, 1 physicist, 1 chemist.....	3
Eight associate and assistant physicists, 1 assistant chemist.....	9
Fifteen laboratory assistants, 1 librarian, 1 computer, 1 draftsman.....	18
One secretary, 4 clerks, 2 messengers, 1 storekeeper.....	8
Four mechanics, 2 woodworkers, 3 apprentices, 2 laborers.....	11
One engineer, 1 assistant engineer, 1 electrician, 2 firemen, 2 watchmen, 1 janitor, 1 charwoman.....	9
Total.....	58

The staff will be increased to 71 at the beginning of the new fiscal year.

The library contains 1,949 bound volumes, together with a number of pamphlets, reprints, and miscellaneous scientific reports. It consists entirely of books of a purely technical character, dealing directly with or closely related to the work of the Bureau. During the year 1,165 volumes have been added. Acquisitions by purchase have been, in general, books that were not available in the other libraries of the city or were in such constant use as to require that copies be immediately at hand. The privileges of nearly all the libraries of the city have been extended to the Bureau. Many books have been borrowed from them during the year and much assistance has been rendered by the several librarians. A complete author and subject catalogue of the works on hand has been prepared. Through the card distribution of the Library of Congress the Bureau possesses a complete author and subject catalogue of that Library's collection, so far as cards have been printed, in the subjects relating to the work of the Bureau. Titles are being continually added as they appear, and ultimately the card catalogue of both collections will be complete. The library has been conducted as a reference and circulating library available to members. The total loan circulation for the year was 1,206 volumes. Of this number 932 were from the Bureau collection and 274 were loaned by other libraries.



*Number and value of tests completed during fiscal year ended June 30, 1904.*

Nature of test.	For Government.		For public.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
Length .....	125	\$162.00	97	\$239.15	222	\$401.15
Mass .....	219	178.50	389	245.25	608	423.75
Capacity .....	670	311.00	40	63.00	710	374.00
Photometry .....	513	57.70	76	93.50	589	151.20
Temperature .....	1,750	294.20	3,559	591.27	5,309	885.47
Electrical .....	36	166.00	131	522.65	167	688.65
Sundry .....	144	144.00	7	7.50	151	151.50
Total .....	3,457	1,313.40	4,299	1,762.32	7,756	3,075.72

The number of tests made for the Government in 1903-4 was 174 per cent greater than in the preceding fiscal year, and the number of tests for the public was 961 per cent greater, the increase in tests for both Government and public amounting to 366 per cent.

The receipts for tests were as follows:

Total receipts, 1903-4 .....	\$1,745.87
Previously received for tests in progress, 1903-4 .....	\$72.00
Subsequently received for tests completed, 1903-4 .....	29.05
	101.05
Received for tests completed, 1902-3 .....	46.00
Received for tests in progress .....	38.60
	84.60
Fees for tests completed, 1903-4 .....	1,762.32

#### FINANCIAL STATEMENT.

##### APPROPRIATIONS, 1901-2.

[Corrected to July 1, 1904.]

Appropriations.	Disbursements.	Liabilities.	Balance.	Total.
Laboratory .....	\$261,171.07	\$63,542.64	\$286.29	\$325,000.00
Site .....	25,000.00			25,000.00
Salaries, 1902 .....	21,959.76		5,180.24	27,140.00
Equipment, 1902 .....	9,915.69		84.31	10,000.00
General expenses, 1902 .....	4,894.81	40.06	65.13	5,000.00
Total .....	322,941.33	63,582.70	5,615.97	392,140.00

##### APPROPRIATIONS, 1902-3.

[Corrected to July 1, 1904.]

Salaries, 1903 .....	\$32,559.93		\$3,500.07	\$36,060.00
Equipment, 1903 .....	28,265.35	\$1,711.20	23.45	30,000.00
General expenses, 1903 .....	4,939.97	42.80	17.23	5,000.00
Total .....	65,765.25	1,754.00	3,540.75	71,060.00

##### APPROPRIATIONS, 1903-4.

Salaries, 1904 .....	\$69,754.59		\$4,945.41	\$74,700.00
Equipment, 1904 .....	66,965.47	\$42,953.80	80.73	110,000.00
General expenses, 1904 .....	9,232.48	1,277.89	239.63	10,750.00
Grounds, 1904-5 .....	500.00			500.00
Total .....	146,452.54	44,231.69	5,265.77	195,950.00

Respectfully,

S. W. STRATTON, *Director.*

The SECRETARY OF COMMERCE AND LABOR.





